Reflections on Marvin Minsky's Definition of "Model"

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Abstract: "To an observer B, an object A* is a model of an object A to the extent that B can use A* to answer questions that interest him about A." This definition includes concrete, tangible models as well as conceptual models that are described in (usually formal) languages.

stakeholders and further applying their actions to the system constitutes an additional challenge.

Modelling for sustainability can be defined as the usage of modelling methodologies to consciously "optimise" sustainable usage of resources. However, if such studies are to have a significant impact on sustainability, Informatics must be used as a tool to translate complex and domain-specific assessments to non-experts and decision makers.

3.13 Modeling for Sustainability

Øystein Haugen (Ostfold University College – Halden, NO)

What is a Model? What is Modeling? What is Modeling for Sustainability? Models should execute/behave and mimic a referent system. Modeling is the creation and evolution of a model. Modeling for sustainability is when the referent system is concerned with sustainability.

3.14 Modeling to Reduce Waste in Chemical Production

Øystein Haugen (Ostfold University College – Halden, NO) and Per-Olav Hansen

This talk presented a use-case in the European ECSEL project Productive4.0 owned by Unger Fabrikker in Norway and executed by the Norwegian consortium in Productive4.0. The use-case is about reducing the waste originating from the transition period between the production of two high-quality chemical products. During the transition period, no proper product is produced and this produce must be further handled as waste. The purpose of the use-case is to find models that can make it possible to reduce the transition period and the amount of potential waste.

3.15 Reflections on Marvin Minsky's Definition of "Model"

Lorenz Hilty (Universität Zürich, CH)

"To an observer B, an object A* is a model of an object A to the extent that B can use A* to answer questions that interest him about A." [1], p. 426.

This definition includes concrete, tangible models as well as conceptual models that are described in (usually formal) languages. The definition has some fruitful implications:

- The purpose of a model can be described by specifying the type of questions the model is intended to answer about the original (A).
- The purpose of a model is connected to the (epistemic) interest of an observer.

- There can be multiple models of the same original, depending on the purpose. Zeigler calls two models complementary if they embody consistent hypotheses about the original (but in a different way), and competitive if they embody mutually exclusive hypotheses [2], p. 13.
- The term "representation" can be avoided in the definition of "model". I consider this an advantage because "representation" is a term that raises many epistemological issues.
- The terms "abstraction" and "simplification" can be avoided in the definition of "model". Characterizing models as abstractions or simplifications implies there could be an entity that is "no abstraction" or "no simplification" of another entity (something like a "perfect copy", which is however not a model because it is no abstraction or simplification), an idea that again raises epistemological issues.
- Both descriptive and prescriptive models can be subsumed under Minsky's definition, namely in the following way: If A already exists, the model is descriptive, otherwise (if A is to be created), the model is prescriptive. In the latter case, the "questions that interest [the observer] about A" are addressing the consequences of design decisions regarding A. If A exists and we are interested in future changes A may undergo (or of impacts A will be subjected to), the model is descriptive and prescriptive.
- We can ask how a model is used to generate answers to questions. "Generating aswers" is often done by some sort of experimentation, e.g., by setting parameters and initial conditions to create an instance of the model and let an algorithm interpret it. Simulation can thus be defined as experimenting with a model. (If there is no need for experimentation, we are in the exceptional situation that the model is simple enough to be treated analytically.)
- Because a model is not a statement, but a generator for a (usually infinite) set of statements about the original, it is usually not verifiable, but falsifiable.

References

1 Marvin L. Minsky. *Matter, Mind and Models.* MIT Press, Boston MA, USA, 1968
2 Bernard P. Zeigler. *Multifacetted Modelling and Discrete Event Simulation.* Academic Press, London, GB, 1984

3.16 Sustainability: Scientific Theories and Models

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Joint work of Diverse Team, at IRISA/Inria Rennes

A Model is an abstraction of an aspect of the world for a specific purpose. Therefore a Scientific Theory for supporting sustainability is a Model (but a Model is not always a Scientific Theory, eg. because it might not be falsifiable). In facts, Creating a Scientific Theory is (evermore) Writing Software. Conversely writing (useful) Software is like Creating a Scientific Theory, with validation tests playing the role of experiments in science. In this talk we explore how MDE technology could be used to support scientific theories of sustainability.